

BOLIVIA

MISICUNI RENEWABLE ENERGY HYDROELECTRIC PROJECT

(BO-L1043)

LOAN PROPOSAL

This document was prepared by the project team consisting of: Emilio Sawada (ENE/CPR) and Alberto Levy Ferre (INE/ENE), Project Team Co-leaders; Alejandro Melandri (INE/ENE); Gastón Astesiano (INE/ENE); Camilo López (INE/ENE); Jorge Ordoñez (INE/ENE); Diego Buchara (LEG/SGO); Emmanuel Boulet (VPS/ESG); Jonathan Renshaw (VPS/ESG); Roberto Laguado (CAN/CBO); Mariano Perales (CAN/CBO); and Marcelo Barros (CAN/CBO); under the supervision of Leandro Alves, Chief of the Energy Division (INE/ENE/CHF), and Baudouin Duquesne, Country Representative (CAN/CBO).

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Proposed resolution

ELECTRONIC LINKS

Required

1. Annual work plan (AWP):

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2240500>

2. Monitoring and evaluation arrangements:

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2200820>

3. Environmental and Social Management Report (ESMR) and Environmental Management Plan (EMP) for the project:

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2225285>

4. Procurement plan:

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2203496>

5. Safeguard Screening Form for classification of projects:

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2240969>

Optional

6. Operating Regulations:

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2220908>

7. Phase 0 technical review – Misicuni Hydroelectric Project (MHP):

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2202655>

8. Preliminary environmental impact assessment of the MHP and the transmission line:

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2041081>

9. Preliminary environmental impact assessment of the Misicuni Multiple Project (MMP):

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2045723>

10. Executive summary of the financial analysis:

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2202499>

11. Economic analysis:

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2225018>

12. General design and cross-section view of the MMP:

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2203738>

13. Implementation and management plan

<http://idbdocs.iadb.org/WSDocs/getDocument.aspx?DOCNUM=2227842>

ABBREVIATIONS

| | |
|-------------------|--|
| AE | Autoridad de Fiscalización y Control Social de Electricidad [Electrical Power Oversight Authority] |
| AWP | Annual work plan |
| BTU | British Thermal Units |
| CNDC | National Load Dispatch Committee |
| EIRR | Economic internal rate of return |
| EMP | Environmental Management Plan |
| ENDE | Empresa Nacional de Electricidad |
| ENPV | Economic net present value |
| ESMR | Environmental and Social Management Report |
| FSO | Fund for Special Operations |
| GWh | Gigawatt hour |
| ha | Hectare |
| ICAS | Institutional Capacity Assessment System |
| IDB | Inter-American Development Bank |
| km | Kilometer |
| m ³ /s | Cubic meters per second |
| masl | Meters above sea level |
| MHP | Misicuni Renewable Energy Hydroelectric Project |
| MMP | Misicuni Multiple Project |
| MW | Megawatt |
| NIS | National Interconnected System |
| OC | Ordinary Capital |
| PEU | Project execution unit |

PROJECT SUMMARY

**BOLIVIA
MISICUNI RENEWABLE ENERGY HYDROELECTRIC PROJECT
(BO-L1043)**

| Financial Terms and Conditions | | | | | |
|--|-------------------------------|----------|--|---|------------|
| Borrower: Plurinational State of Bolivia | | | Type of funds | OC | FSO |
| Executing agency: Empresa Nacional de Electricidad (ENDE) | | | Amortization period: | 30 years | 40 years |
| Source | Amount (US\$ millions) | | Grace period: | 6 years | 40 years |
| | Program | % | Disbursement period: | 5 years | 5 years |
| IDB (OC) | 70.7 | 62.0 | Interest rate: | SCF-Fixed | 0.25% |
| IDB (FSO) | 30.3 | 26.5 | Inspection and supervision fee: | * | |
| Local | 13.1 | 11.5 | Credit fee: | * | |
| | | | Currency: | U.S. dollars from the Single Currency Facility (SCF) of the Bank's Ordinary Capital | |
| Total | 114.1 | 100.0 | | | |

Project at a Glance

Project objective/description:

The objective of the Misicuni Multiple Project (MMP) is to supply drinking and irrigation water to the Cochabamba Valley, while generating electricity for the National Interconnected System (NIS), using water from the Misicuni River watershed. The specific objective of the Misicuni Renewable Energy Hydroelectric Project (MHP), which is part of the MMP, is to add 80 megawatts (MW) of installed power generation capacity to the NIS and produce 217 gigawatt hours (GWh) of electricity annually. The Bank will finance the MHP.

Conditions precedent to the first disbursement (paragraph 4.7):

(i) approval by the ENDE board of directors of the project Operating Regulations, which include the environmental and social conditions that the project must meet, established in Section VIII of the Environmental and Social Management Report (ESMR); (ii) formal creation of the project execution unit (PEU), appointment of its coordinator, and appointment of the core team as established in the Operating Regulations, including the technical, environmental and social, accounting and financial, and procurement specialists; (iii) compliance with the environmental and social obligations established in the ESMR, Section VIII, paragraph 8.3; and (iv) signature of the subsidiary agreement between the borrower and ENDE by which the borrower transfers the loan proceeds to ENDE and ENDE assumes the obligations of the loan contract.

Special conditions for execution (paragraph 4.8): Prior to the call for proposals for each of the infrastructure works to be financed with loan proceeds, the executing agency will present, to the Bank's satisfaction, evidence of the following: (i) the final report on the technical aspects of the project, especially the basic and detailed engineering designs for the works, reviewed by an independent engineer hired by the Bank; (ii) the respective environmental permit approved by the competent authorities has been issued and is current; and (iii) the environmental and social obligations defined in Section VIII of the ESMR are being met. In addition, the executing agency will present, to the Bank's satisfaction: and (iv) an annual report on the financial position of ENDE, including its audited financial statements; and (v) a semiannual report on the project's technical aspects, reviewed by an independent engineer hired by the Bank.

Exceptions to Bank policies: None

Project qualifies as: SEQ [] PTI [] Sector [] Geographic [] % of beneficiaries []

Procurement: MHP procurements will be in accordance with Bank policies and procedures, as defined in documents GN-2349-7 and GN-2350-7. No exceptions to Bank policies are anticipated (Annex III).

* The credit fee and inspection and supervision fee will be established periodically by the Board of Executive Directors as part of its review of the Bank's lending charges, in accordance with the applicable provisions of the Bank's policy on lending rate methodology for Ordinary Capital loans. In no case will the credit fee exceed 0.75% or the inspection and supervision fee exceed, in a given six-month period, the amount that would result from applying 1% to the loan amount divided by the number of six-month periods included in the original disbursement period.

I. BACKGROUND AND RATIONALE

A. The Misicuni Multiple Project

- 1.1 The objective of the Misicuni Multiple Project (MMP) is to increase the supply of water for domestic use and irrigation to the Cochabamba Valley while generating electricity for the National Interconnected System (NIS). Cochabamba is a region in Bolivia that is increasingly suffering from a scarcity of water both for human consumption and for agriculture. Furthermore, the country needs to expand its generation capacity to meet the growing demand for electricity. The MMP will help to meet all of these needs.
- 1.2 The MMP will dam and divert water from the Misicuni River, located at 3,700 meters above sea level (masl), to the Cochabamba Valley at 2,700 masl. Water will be channeled in a direction opposite to the flow of the river through a 20-kilometer tunnel that cuts through mountainous terrain. This tunnel will connect to a pressurized piping system that will transport the water to a power plant roughly 1,000 meters below that generates electricity.¹
- 1.3 The project will require construction of a 120-meter high concrete-faced rockfill dam, a pressurized piping system, a power plant, and related works. A tunnel with a diameter of 2.2 to 2.6 meters, which will connect the reservoir to the pressurized piping system, was completed in 2005 with financial support from the Government of the Republic of Italy. Thanks to this tunnel and a temporary water intake on the Misicuni River, water is being supplied to Cochabamba, although the average volume of 0.15 cubic meters per second (m³/s) is substantially less than the 3.2 m³/s capacity projected for the project. The dam, which has an estimated cost of US\$85 million, is also being financed by the Italian government, the Prefecture of Cochabamba, the National Treasury, and the Andean Development Corporation. Dam construction, which began in June 2009, is expected to be completed in 42 months.²
- 1.4 The loan from the Inter-American Development Bank will finance the hydroelectric component of the MMP, whose estimated cost is US\$114.1 million, including electric power transmission and related works. The Bank will contribute US\$101 million and the remaining amount will be covered by the local counterpart.

B. The Misicuni Renewable Energy Hydroelectric Project

- 1.5 The Misicuni Renewable Energy Hydroelectric Project (MHP), which is part of the MMP, will use water from the dam to provide an estimated annual average flow of 3.2 m³/s. The MHP includes: (i) a 700-meter extension of the existing tunnel in the El Calio area; (ii) a steel penstock that is 1.6 meters in diameter and 3,800 meters long; (iii) a power plant located in Molle Molle at 2,740 masl; (iv) a 7-hectare (ha) equalizing reservoir located close to the power plant; and (v) a substation and

¹ Another phase is planned that includes an additional 20 kilometers of tunnels to draw water from the Viscachas and Putucuni Rivers. Given their magnitude, these investments are not expected to be executed in the short term.

² The construction consortium is made up of firms from Italy, Bolivia, Colombia, and Venezuela.

transmission line. From the reservoir, approximately 2 m³/s of water will be diverted to a water treatment plant to supply the Servicio Municipal de Agua Potable y Alcantarillado [Municipal Water and Sewer Service of Cochabamba] and other municipios in order to expand and improve water services to the population,³ and 1 m³/s of water will be supplied to irrigate some 2,600 ha of farmland.

Figure I-1 - MMP general design and cross-section view

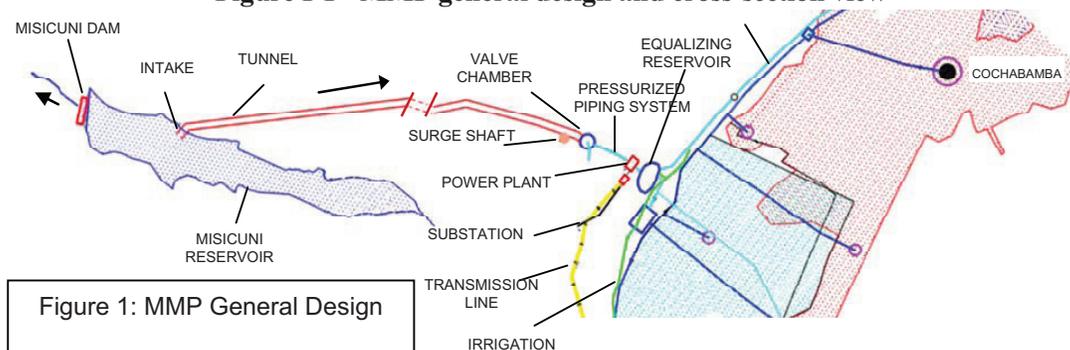


Figure 1: MMP General Design

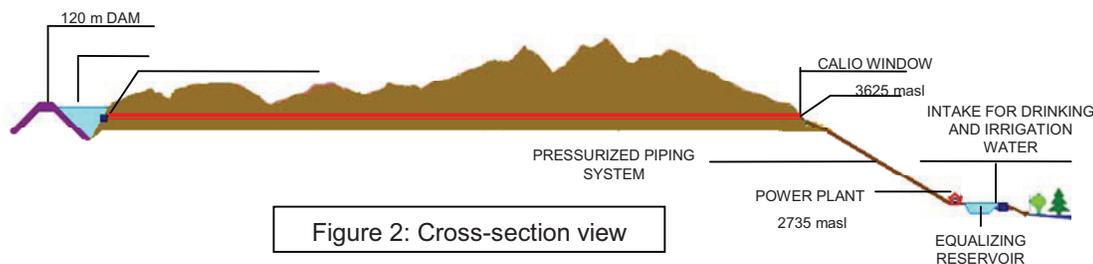


Figure 2: Cross-section view

- 1.6 The hydroelectric plant will have an installed capacity of 80 megawatts (MW) and will provide 217 gigawatt hours (GWh) of electricity annually. The NIS has a total installed capacity of 1,140 MW, and a peak-demand generating capacity of approximately 900 MW. Given the limited flow of water, the hydroelectric plant will operate during the peak-demand hours (approximately 7.5 hours a day). In order to regulate the supply of drinking and irrigation water consonant with demand, a 300,000-m³ equalizing reservoir will be built.⁴

C. Bolivia's electricity sector

- 1.7 Bolivia's electricity sector is governed by Electricity Law 1,604 of 1994. Electricity can be purchased and sold in the wholesale electricity market through contracts or on the spot market where transactions are based on prices set each hour according to the marginal costs of power generation.
- 1.8 The National Load Dispatch Committee (CNDC) is responsible for dispatching electricity and has the following functions: (i) planning integrated operation of the NIS to meet demand through safe, reliable operation at the lowest possible cost; (ii) dispatching power in real time; (iii) determining the actual capacity of the NIS

³ The Cochabamba Valley has approximately 1.1 million inhabitants.

⁴ The related construction works for drinking and irrigation water, which take water from the equalizing reservoir, are expected to be financed by the Prefecture of Cochabamba and the Bolivian government

- generation units; (iv) calculating the node prices and presenting them to the Electrical Power Oversight Authority (AE) for approval; and (v) providing information to the AE.⁵
- 1.9 The NIS's power generation, transportation, and distribution are provided by private and semi-public companies, and by the State-owned Empresa Nacional de Electricidad (ENDE).⁶ National electricity coverage is 80% (85% in urban areas and 30% in rural areas). The power generation subsector is a free market system, while the transmission and distribution subsectors have been structured as regulated natural monopolies whose rates are set by the AE.
- 1.10 As a result of constitutional reform, the government has been strengthening its presence in the sector, especially through ENDE, which has been declared a strategic and collective State-owned enterprise (Supreme Decree 29644/2008). The executive branch has also transferred to ENDE the shares that the Collective Capitalization Fund had in the power generation companies Corani, S. A., Guaracachi, S. A., and Valle Hermoso, S. A. (Supreme Decree 0289 of 9 September 2009).⁷ These three companies were created in 1995 as a result of the electricity sector's capitalization process by which strategic partners were selected who own the majority of shares and operate the companies. The Bolivian authorities intend to acquire a majority share of these three companies through a bilateral negotiation process in which the private sector actors would have the option to continue as operators.
- 1.11 The executing agency for the MHP, ENDE, is a State-owned enterprise that has its own assets and is authorized to participate in the different market sectors (power generation, transmission, distribution, and off-grid systems), for which it will create separate companies for each activity. ENDE, headquartered in the city of Cochabamba, has a nationwide presence in all sectors of the electricity industry and acts under the authority of the Ministry of Hydrocarbons and Energy. Its operation is subject to the by-laws approved by the executive branch. ENDE has technical, administrative, financial, and legal autonomy for purposes of meeting its objectives.
- 1.12 ENDE is managed by a board of directors made up of the Ministers of Hydrocarbons and Energy, Treasury and Public Finance, Environment and Water Resources, Public Works, Services and Housing, and Development Planning, or their respective representatives. The Minister of Hydrocarbons and Energy chairs the board of directors. ENDE's top executive is its general manager, appointed by the President of the Plurinational State of Bolivia from a shortlist proposed by the

⁵ The CNDC is made up of one representative each from the power generation companies, transmission companies, distributors, unregulated consumers, and the AE (formerly the Superintendency of Electricity), with the latter serving as the chair of the Committee.

⁶ The NIS has nine power generation companies, two transmission companies, and six distributors. The main off-grid systems are the Tarija, Beni, and Pando systems.

⁷ The Collective Capitalization Fund is a special-purpose financial vehicle that holds the shares transferred to citizens as part of the capitalization process of State-owned enterprises during the 1990s. The pension fund administrators have been in charge of managing these shares. As of this transfer, ENDE will exercise shareholder rights in the three companies.

Plurinational Legislative Assembly. ENDE is financed with its own funds, grants, government transfers, and domestic and foreign financing.

- 1.13 The Ministry of Hydrocarbons and Energy draws up sector policies through the Office of the Deputy Minister for Electricity and Alternative Energy. Supreme Decree 0071/2009 created the AE, which replaced the Superintendency of Electricity as the regulatory and oversight agency for the sector. The AE is a legally constituted public, technical, and operational institution with its own assets and has administrative, legal, and technical autonomy under the Ministry of Hydrocarbons and Energy. Market agents can appeal AE decisions to the Ministry of Hydrocarbons and Energy and thereafter request judicial review before the courts.
- 1.14 **Public Utilities Policy (OP-708).** The MHP is consistent with the objectives set forth in the Bank's Public Utilities Policy. Nevertheless, some aspects of the Bolivian electricity sector warrant analysis in light of the basic conditions of this policy. As a result of the new constitution, the Bolivian government has a policy of greater government involvement in the electricity sector, which includes strengthening ENDE. The government is in the process of becoming the majority shareholder in the electric generation, transmission, and distribution companies that were capitalized in the 1990s. It is also studying the possibility of amending Electricity Law 1,604 to provide incentives for more long-term contracts in the electricity generation market through competitive bidding, with no change to the sector structure, set prices for power generation (capacity and energy) and regulated rates (for power transmission and distribution), and private sector involvement. These changes could lead to some uncertainty until the process is completed.
- 1.15 Despite the foregoing observations, it should be noted that the country's electricity system continues to be consistent with the basic guidelines of the Public Utilities Policy: there is a separation of generation, transmission, and distribution activities; electricity is dispatched based on marginal costs; capacity and energy are remunerated;⁸ and there is a regulatory body with administrative, financial, legal and technical autonomy.

D. Rationale for the Misicuni Hydroelectric Project

- 1.16 The MMP, in addition to providing electricity to the NIS, has been proposed as a solution to the growing problem of the lack of drinking water and scarcity of irrigation water in the Cochabamba Valley. Building the MHP is vital for the MMP's economic and financial viability. The benefits of providing electricity to the NIS complement those of supplying drinking and irrigation water. The MHP will help: (i) expand installed hydroelectric generation capacity to meet the growing demand for electricity, which is forecast to rise 6% annually for the next five years; (ii) improve the energy matrix by increasing installed renewable energy capacity and displacing natural gas and diesel power plants; (iii) reduce carbon dioxide emissions into the atmosphere, decreasing greenhouse gas emissions; (iv) free up natural gas for export at regional market prices, which are approximately US\$5 per million British Thermal Units (BTUs); and (v) reduce subsidies for natural gas used

⁸ At present, the capacity charge is Bs 58.49 per kilowatt month and the energy charge is Bs 133.16 per megawatt hour.

to run thermoelectric power plants, which is priced at approximately US\$1.3 per million BTUs.

E. The Bank's country strategy with Bolivia

- 1.17 The Bank's country strategy with Bolivia (document GN-2485-2) gives priority to the issues of poverty, social exclusion, and access to basic social services, identifying lines of activity such as providing safe drinking water, supporting production infrastructure, and making energy inputs available. The MHP is consistent with these policies inasmuch as it will help supply drinking and irrigation water to the Cochabamba Valley, as well as electricity to the NIS. Improvements in water availability will help mitigate one of the most significant obstacles to economic, social, and cultural development in Cochabamba. In addition to the loan for the MHP, the Bank is preparing a Rural Electrification Program (BO-L1050) that will support projects that provide electricity to rural and isolated areas in Bolivia.

II. OBJECTIVES, COMPONENTS, AND COSTS

- 2.1 The objective of the Misicuni Multiple Project (MMP) is to supply drinking and irrigation water to the Cochabamba Valley, while generating electricity for the NIS, using water from the Misicuni River watershed. The specific objective of the Misicuni Renewable Energy Hydroelectric Project (MHP), which is part of the MMP, is to add 80 MW of installed power generation capacity to the NIS and produce 217 GWh of electricity annually. The Bank will provide financing for the MHP, which will help: (i) expand the installed power generation capacity of the NIS to meet the growing need for electricity, especially during peak-demand hours; (ii) improve the energy matrix by increasing the share of renewable energy; and (iii) reduce subsidies to the sector and free up natural gas for export. The project has two components, one for the infrastructure works and the other to cover engineering, supervision, environmental and social mitigation, and other indirect costs.

2.2 Component I – Infrastructure works

- a. Extension and reinforcement of the low-pressure tunnel: Construction of the remaining 727 meters of the final section of the headrace tunnel and concrete reinforcement of this section and 692 meters of the tunnel that have not been reinforced;
- b. Surge shaft: A vertical shaft that is 2.6 meters in diameter extending up 150 meters from the low-pressure tunnel;
- c. Safety valve: A butterfly valve to close the penstock;
- d. Penstock: Cement anchors, 3,767 meters long and 1.6 meters in diameter, which will carry 9.8 m³/s of water at an approximate speed of 4.8 meters per second;
- e. Power plant: Located at 2,740 masl, it will house two generators driven by 40-MW Pelton turbines;

- f. Watertight equalizing reservoir: Located downriver from the power plant, the equalizing reservoir, measuring 7 ha with a maximum depth of 9 meters, will store up to 300,000 m³ of turbinized water;
 - g. Substation and transmission line: A 230-kilovolt line that is 50 km long (15 km are for the project and 35 km are part of the future line that will connect Cochabamba with La Paz) will connect the power plant to the NIS.
- 2.3 **Component II – Other costs.** This component will cover engineering and supervision costs, contingency costs, and environmental and social mitigation and compensation costs.

A. Cost and financing

- 2.4 The MHP has a total estimated cost of US\$114.1 million. Of this amount, the Bank loan will cover US\$101 million (including the applicable taxes), and the Government of Bolivia will contribute the remainder as counterpart resources. In the case of the Bank’s loan, 70% of the loan will be drawn on Ordinary Capital (OC) and the remaining 30% will be drawn on the Fund for Special Operations (FSO).

Table II-1. Cost and financing of the MHP (US\$ millions)

| Investment component | IDB | Counter-part | Total |
|---|---------------|---------------|----------------|
| I. Infrastructure works | | | |
| a. Tunnel extension, surge shaft, and reinforcement | 10.7 | -- | 10.7 |
| b. Pressurized piping system and safety valve | 29.2 | -- | 29.2 |
| c Power plant and related civil works | 5.6 | -- | 5.6 |
| d. Equipment (turbines and generators) | 27.4 | -- | 27.4 |
| e. Equalizing reservoir | 5.4 | -- | 5.4 |
| f. Substation and transmission line | 10.2 | -- | 10.2 |
| II. Other costs | | | |
| a. Environmental and social impact mitigation | 3.2 | -- | 3.2 |
| b. Engineering and supervision of works | 6.4 | -- | 6.4 |
| c. Audit, administration, and other costs | 2.9 | 1.0 | 3.9 |
| Audit | 0.2 | | 0.2 |
| Administration and other costs | 2.7 | 1.0 | 3.7 |
| d. Contingencies | | 12.1 | 12.1 |
| Total | 101.0 | 13.1 | 114.1 |
| Percentages (%) | (88.5) | (11.5) | (100.0) |

B. Results matrix

- 2.5 The MHP is expected to produce the following results: (i) supply 217 GWh of electricity annually, especially during peak hours; (ii) provide an average of 3.2 m³/s of drinking and irrigation water to the Cochabamba Valley from the equalizing reservoir; and (iii) increase production capacity of 2,600 ha of farmland. The matrix includes the means of verification (information sources and collection systems) and the basic assumptions as a risk proxy. The output indicators include the relevant baselines, as well as intermediate and final outcomes. The output

indicators specified for the construction phase are the most relevant ones and those that allow for the semiannual monitoring required by the Bank (see Annex II).

III. FINANCING STRUCTURE AND MAIN RISKS

A. Financing instruments and contractual conditions

- 3.1 The operation will be structured as a sovereign-guaranteed investment loan, 70% of which will be drawn on the Ordinary Capital over a 30-year term, and the remaining 30% drawn on the FSO over a 40-year term. The disbursement period will be five years, according to the following tentative timetable.

Table III-1. Disbursement schedule (US\$ millions)

| Source | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Total |
|--------|--------|--------|--------|--------|--------|-------|
| IDB | 2.6 | 33.1 | 34.3 | 21.5 | 9.5 | 101 |
| % | 3 | 33 | 34 | 21 | 9 | 100 |

B. Environmental and social safeguard risks and mitigation measures

- 3.2 The primary focus of the Bank’s loan is construction of the hydroelectric plant, transmission lines, and related works. However, the environmental and social analysis will consider the MMP as a whole, including the impact of construction of the Misicuni dam, which is not being financed by the Bank, but is necessary for the functioning of the MHP. Based on the potential impacts identified, the project has been classified as a category “A” operation. An Environmental and Social Management Report (ESMR) has been prepared that includes a detailed analysis of the impacts and mitigating measures associated with construction of both the hydroelectric plant and the Misicuni dam.
- 3.3 The MMP is located in Tunari National Park, which is a protected area. There is a great deal of human activity within park boundaries, but still no Environmental Management Plan (EMP) for the park. An environmental permit has been issued by the Ministry of the Environment and Water Resources for the MMP. The park does not require an EMP to initiate works under the MMP inasmuch as the latter has been declared by law to be a strategic, priority project. Of the park’s 300,000 ha, the MMP will directly affect 743 ha, which is approximately 0.25% of its total area.⁹
- 3.4 The most significant permanent environmental impacts related to the construction and operation of the MMP are: (i) the involuntary resettlement of 175 families from eight indigenous communities in the area of the Misicuni dam, as well as the economic displacement of some 200 families that have farmland in the area where the reservoir will be located, with the resulting decrease in production activities; (ii) change in land use in one part of Tunari National Park due to the permanent installation of construction works and their impact on the natural habitat; (iii) changes in the flow and quality of water from the dam downstream on the

⁹ In order to support preparation of an EMP for the park, the Bank is planning a technical cooperation operation for the Servicio Nacional de Áreas Protegidas [National Protected Areas Service], which manages national parks, in coordination with other development agencies.

- Misicuni River; (iv) health and safety risks to the communities near the dam and the equalizing reservoir; and (v) potential environmental degradation due to major construction in a sensitive area.
- 3.5 As specifically regards construction of the MHP, the transmission line, and related works, which will be financed by the Bank loan, the main risks are: **during construction:** (i) the direct impact on lands that will be purchased; (ii) the indirect impact on the communities that farm in the project area (e.g. dust in the fields); (iii) removal of trees (*kewiña*) in a strip along the pressurized pipeline; and (iv) handling and disposal of surplus soil excavated from the construction site; **during operation:** (i) restricted access to the strip where the pressurized pipeline and transmission line are located; (ii) noise during the hours of operation of the power plant; and (iii) potential problems with the equalizing reservoir and handling of the water, for which a contingency plan is required.
- 3.6 The flooding of the reservoir is not expected to have a significant impact on any protected plant or animal species.¹⁰ To mitigate the project's indirect impact on the Misicuni watershed—specifically, erosion and its adverse effect on fragile natural habitats such as the alpine peatlands known as bofedales—the Bank is preparing another loan to provide support in this area (Misicuni Watershed Environmental Management Project, BO-L1053, for US\$53 million). This loan will be executed by Empresa Misicuni.
- 3.7 Resettlement plans have been drawn up that are consistent with Bank policies on Involuntary Resettlement (OP-710) and Indigenous Peoples (OP-765). Most activities related to the resettlement plan in the dam area have already been implemented. The component pending implementation is the program for recovery and support of production activities. The Misicuni Watershed Environmental Management Project (BO-L1053) includes activities to diversify and strengthen production activities in the affected communities. Successful implementation of that operation is indispensable for restoring the economic capacity of the affected communities and ensuring compliance with policies OP-710 and OP-765.
- 3.8 A permanent minimum flow of water of 200 liters per second has been established downstream from the dam, which is 95% of the flow during the dry season. This is the minimum flow that must be maintained after the diversion tunnel has been closed. An adaptive ecological water flow management plan will be prepared that includes provisions on periodic monitoring of water quantity and quality and the inventory of aquatic and riparian flora and fauna on the Misicuni River downstream from the dam. The final design of the minimum flow discharge structure will help ensure water quality similar to that which currently exists in the Misicuni River.
- 3.9 A conceptual framework for contingency plans has been developed both for the Misicuni dam area and for the MHP. Specific and detailed contingency plans will be prepared and completed at least one year prior to closing the Misicuni reservoir diversion tunnel and before MHP operations, including the equalizing reservoir, are initiated.

¹⁰ A study and assessment has been conducted of the flora and fauna during the dry season, which will be followed up with studies during the rainy season to confirm that there are no significant impacts.

C. Fiduciary risks

- 3.10 ENDE's institutional capacity to execute the MHP was evaluated during project preparation. The Institutional Capacity Assessment System (ICAS) was used, which covers: (i) planning and organizational capacity (planning of activities and organizational management); (ii) execution capacity (personnel, goods and services, and financial management); and (iii) control (internal and external) capacity. The ICAS concluded that ENDE presents a medium risk and that the ENDE executing unit for the Bank loan, which is being created, will need to be strengthened to guarantee proper execution of the loan. In light of the foregoing, the Bank approved nonreimbursable technical cooperation,¹¹ part of which will be used to hire technical support specialists to strengthen the project execution unit (PEU).
- 3.11 ENDE has never executed an operation with the Bank. However, it is executing operations with the Andean Development Corporation for the construction of: (i) a transmission line between Caranavi and Trinidad (US\$32.2 million); and (ii) a transmission line to connect Tarija to the NIS (US\$44 million). Furthermore, it is executing a thermoelectric power generation project with a mixed-ownership firm (Entre Ríos) in which it is the majority shareholder. The PEU responsible for executing the Bank loan will be able to draw on these experiences at ENDE, especially the skills of staff who have already received training.

D. Technical feasibility

- 3.12 During project preparation, an independent review was conducted of both the MHP and the MMP, which concluded that the MHP could reasonably supply electricity to the NIS in an efficient manner. This conclusion is based on the following: (i) the water flow intake, regulation, and conveyance works have already been built or are in the process of being executed; (ii) the major ex ante uncertainties associated with this type of project tend to be the geological risks of building the headrace tunnel, which, in this case, is nearly completed and already partially in use; (iii) the availability of a nearly 1,000 meter drop between the end of the tunnel and the power plant and the ability to regulate the flow of water are key cost-efficiency factors (high volume and low variability of flow); and (iv) the risk of dam failure is minimized by the adoption of generally accepted industry standards in the design of spillway capacity, and by the selection of a type of dam with very little susceptibility to catastrophic failures.

E. Economic feasibility

- 3.13 The conceptualization and design of the MMP have been analyzed over a period of 35 years, including the following: a prefeasibility study by Sofrelec (France, 1975); a feasibility study by Lavalin (Canada, 1979); designs by Electrowatt (Switzerland, 1987); supplemental designs completed after TAMS-Ingetec drilled the conveyance tunnel (USA-Colombia, 2003); and a final review by ENDE (Bolivia, 2008). Recently the consultant R.W. Beck (United States) conducted a general review and

¹¹ Support for Preparation of the Misticuni Renewable Energy Hydroelectric Project (BO-T1117, in execution ATN/OC-11787-BO), with resources from the Infrastructure Project Preparation Fund.

recommended some specific changes. The CNDC participated in the final designs for the interconnection from the power plant to the 230-kilovolt grid. TAMS-Ingetec did a cost comparison of the various MMP design options and concluded that the alternative with the lowest average cost over the long term was a power plant with an initial capacity of 80 MW, providing drinking and irrigation water services.¹²

- 3.14 **Methodology and data.** Economic feasibility has been studied through a least-cost analysis of the MHP and a cost-benefit analysis of both the MHP and the MMP. Efficiency prices from June 2009 were considered, expressed in free foreign exchange held by the Bolivian government (border prices). The shadow prices ratios are calculated using the accounting factors estimated by the Public Investment Bureau to correct market prices to efficiency prices in the consumption numeraire. The social discount rate adopted was 12%. To assess the benefits, the following were considered: (i) the increase in the supply of safe drinking water (part of the population is not connected to the water supply system and must rely on wells or buy water delivered by tanker trucks); (ii) the increase in agricultural production as a result of irrigating 2,600 ha; and (iii) the replacement of thermoelectric generation capacity with hydroelectric generation capacity.
- 3.15 **Least-cost analysis.** The comparison of the total economic cost of generating power using the hydroelectric power plant versus the best thermoelectric option, which consists of two air-cooled gas turbines, shows that the hydroelectric option would save US\$62.55 million at border prices, assuming that the long-term opportunity cost of gas is on the order of US\$8 per million BTUs and that the hydroelectric option represents a 20.65% share of the cost of the storage reservoir. Opting for hydroelectric power is a sound decision and saves US\$38.71 million even when the opportunity price of gas is calculated at just US\$5 per million BTUs. The other hydraulic works associated with the hydroelectric option under the MMP have been designed to ensure that expansion is achieved at the lowest possible economic cost.
- 3.16 **Cost-benefit analysis.** Payment for turbinated water will be in the form of a transfer between public sector agencies, which means that its cost is nil for purposes of the cost-benefit analysis. As the investments already made in the conveyance tunnel are sunk costs, they have not been considered, nor have those of the equalizing reservoir because it is only needed to regulate the flow of turbinated water for use in irrigation and the water supply system. Furthermore, because the main reservoir is required to ensure constant water flow to the power plant, as well as to regulate the flow of irrigation and drinking water, the MHP has been assigned 20.65% of the direct cost of dam construction for the purposes of evaluation, as this is the share of net economic benefits that will accrue to the MHP as compared to the MMP. Given that there is no detailed simulation of load shedding from the power plant and that most of the current supply is thermoelectric power, it has been assumed that the

¹² Although a 120-meter dam is not required for the first phase, it will be built to this height in anticipation of the completion of the tunnels from the Putucuni and Viscachas Rivers in the medium term.

MHP does not provide incremental electricity and that the entirety of its production is used to replace more expensive thermoelectric energy.

- 3.17 **Results of the MHP analysis.** In keeping with the hypotheses described, and assuming the opportunity cost of gas to be US\$8 per million BTUs, the MHP has an economic net present value (ENPV) of US\$19.4 million and an economic internal rate of return (EIRR) of 14.5%. A sensitivity analysis shows that if the opportunity price of gas falls to US\$6 per million BTUs, the EIRR decreases to 12.4% and the ENPV to US\$2.5 million; if gas falls to US\$5.50 per million BTUs, the respective values are 11.8% and US\$1.2 million. If the investment cost of the MHP increases 20%, the EIRR falls to 11% and the ENPV drops to US\$10 million. It has also been observed that the indicators are not sensitive to the operation and maintenance costs of the MHP. If construction were delayed one year, the ENPV would be US\$13.8 million and the EIRR would be 13.9%. The MHP is viable, and the sensitivity analysis lends confidence to this determination.
- 3.18 **Results of the MMP analysis.** In the absence of reliable economic data to quantify the benefits associated with irrigation, the MMP economic assessment is conservative as it estimates these benefits by fixing the value of irrigation water at its long-term marginal production cost. The MMP indicators are nevertheless highly satisfactory, with an ENPV of US\$93.3 million and an EIRR of 17.5%. If the benefits associated with irrigation were calculated based on the change in the price of irrigated land, the indicators would be even higher. The factor to which the MMP is most sensitive is the price of gas, although even if is the price were US\$5 per million BTUs, the ENPV would be US\$56.8 million and the EIRR would be 15.4%. The indicators would remain high even if the MMP were delayed one year, although its ENPV would fall to US\$76.2 million and the EIRR would drop to 16.6%.
- 3.19 **Financial analysis.** The Plurinational State of Bolivia will be the borrower for this operation and, as such it is responsible for paying the Bank the loan interest, fees, and amortization installments. The executing agency will be ENDE, which has agreed with the borrower to repay the amortization installments to the National Treasury. In light of this arrangement, a financial analysis was conducted to determine the project's capacity to make these payments, taking into consideration earnings from capacity and energy charges, turbined water payments to Empresa Misicuni, and operation and maintenance expenses. The following assumptions were considered: (i) a 6% annual growth in demand for electricity over the next five years, and 5% annually thereafter; (ii) remuneration for capacity and energy at current rates for the next five years, with an adjustment of 5% in U.S. dollars thereafter for each five-year period; (iii) provision of electricity for 7.5 hours on average per day; (iv) annual average operating costs of US\$400,000; and (v) remuneration of US\$0.03 per cubic meter of turbined water.
- 3.20 Under these base scenario assumptions, the MHP has the capacity to operate and maintain its infrastructure and repay the loan to the National Treasury. A downside scenario was also developed based on the following assumptions: (i) a 15% increase in construction costs; (ii) a six-month delay in the start of operations; and

(iii) a 10% increase in operation and maintenance costs. The results of this scenario were satisfactory.¹³

F. Others issues and risks

- 3.21 The legislation under discussion for the electricity sector could change some of the conditions considered in the MHP analysis. This issue should be monitored, as should the repurchase of the power generation companies currently being negotiated and the implications for ENDE.

IV. IMPLEMENTATION AND MANAGEMENT PLAN

A. Project execution and management

- 4.1 The Plurinational State of Bolivia will be the borrower for the project, and ENDE will be the executing agency. ENDE will create a project execution unit (PEU) that will report directly to ENDE's general manager. ENDE will be in charge of general coordination, with support from the PEU. The PEU team will include: (i) a coordinator; (ii) a financial management specialist; and (iii) a procurement specialist. They will be assisted in their work by specialists (hydraulic engineer, civil engineer, and environmental engineer) who will work as associate consultants. Additionally, ENDE management will appoint a group of professionals from the company who will act as counterparts and provide support to the PEU and who, together with the hired technical consultants, will make up the PEU technical council.
- 4.2 The basic responsibilities of the PEU will be to: (i) prepare the bid specifications for hiring consultants and procuring goods and services; (ii) organize and monitor the bidding processes; (iii) award and manage contracts; and (iv) conduct technical and administrative oversight and supervision of contracts for goods and consulting services required for effective implementation of the MHP.
- 4.3 The PEU will also be responsible to the Bank for: (i) coordinating all MHP-related activities; (ii) preparing physical-financial status reports; (iii) delivering no objection and loan disbursement requests and maintaining accounting records, which will be used for preparing such requests and any financial reports; (iv) implementing and maintaining a control system that ensures the proper use and safeguarding of the loan proceeds, as well as maintaining files that document transactions; and (v) preparing and updating the initial project report, annual work plans (AWP), semiannual monitoring reports, evaluation reports, and the project

¹³ It was not considered appropriate to conduct a financial analysis of ENDE because the company is in transition. During the 1990s, ENDE was limited to managing residual assets, especially of off-grid systems. As of the July 2008 decree, ENDE executes and operates electricity projects financed by the Bolivian government. At present, the company has assets equivalent to some US\$147 million, liabilities of US\$33 million, and net worth of US\$114 million, and it bills US\$8.6 million (according to 2008 audited financial statements). Its assets are expected to increase substantially over the next five years, perhaps by as much as 1,000%. It is expected that, *inter alia*, the electricity generation companies capitalized in the 1990s will be reincorporated into ENDE; the Caranavi-Trinidad line, executed by ENDE, is slated to come on line in 2010, as is the Entre Ríos thermoelectric generation plant, executed by the mixed-ownership company ENDE Andina.

completion report, prior to delivery to the Bank. The PEU will act as the permanent liaison between ENDE and the Bank and will be responsible for the timely fulfillment of all clauses in the loan contract and agreements and MHP-related activities.

- 4.4 **Revolving fund.** Proceeds from the Bank's loan will be disbursed to the executing agency using a revolving fund of up to 5% of the loan amount.
- 4.5 **Procurement.** Goods, services, and works will be procured in accordance with the Policies for the Procurement of Goods and Works Financed by the Inter-American Development Bank (document GN-2349-7), and consulting services paid for with MHP resources will be selected and contracted in accordance with the Policies for the Selection and Contracting of Consultants Financed by the Inter-American Development Bank (document GN-2350-7), as set forth in the loan contract and the procurement plan. The summary procurement plan for the first 18 months is presented in Annex III. This plan will be updated annually and whenever substantial changes are made. The Bank will review MHP procurements on an ex ante basis.
- 4.6 **Auditing.** Throughout the MHP execution period, the executing agency will deliver consolidated annual financial statements to the Bank within 120 days after the end of the respective fiscal year. An independent auditing firm acceptable to the Bank will conduct the audit, in accordance with terms of reference previously approved by the Bank (documents AF-300 and AF-400). Procedures set forth in the document on the procurement of external audit services (document AF-200) will be used to select and contract the firm. The cost of the audit will be financed with proceeds from the loan.
- 4.7 **Conditions precedent to the first disbursement: (i) approval by the ENDE board of directors of the project Operating Regulations, which include the environmental and social conditions that the project must meet, established in Section VIII of the ESMR; (ii) formal creation of the PEU; appointment of its coordinator; appointment of the core team as established in the Operating Regulations, including the technical, environmental and social, accounting and financial, and procurement specialists; (iii) compliance with the environmental and social obligations established in the ESMR, Section VIII, paragraph 8.3; and (iv) signature of the subsidiary agreement between the borrower and ENDE by which the borrower transfers the loan proceeds to ENDE and ENDE assumes the obligations of the loan contract.**
- 4.8 **Special conditions for project execution.** Prior to the call for proposals for each of the infrastructure works to be financed with loan proceeds, the executing agency will present, to the Bank's satisfaction, evidence of the following: (i) the final report on the technical aspects of the project, especially the basic and detailed engineering designs for the works, reviewed by an independent engineer hired by the Bank; (ii) the respective environmental permit approved by the competent authorities has been issued and is current; and (iii) the environmental and social obligations defined in Section VIII of the ESMR are being met. In addition, the executing agency will present, to the Bank's satisfaction: and (iv) an annual report on the

financial position of ENDE, including its audited financial statements; and (v) a semiannual report on the project's technical aspects, reviewed by an independent engineer hired by the Bank.

B. Monitoring and evaluation arrangements

- 4.9 **Monitoring.** Throughout execution of the MHP, the executing agency will deliver to the Bank, for its approval, monitoring reports on project activities by 30 May and 30 November at the latest. To this end, the executing agency will have a monitoring system that integrates financial and accounting information and the status of the project. These reports will focus on the fulfillment of output indicators and progress towards the outcomes specified in the results matrix (Annex II), analyze problems encountered, and indicate the corrective measures taken. The reports due by 30 November of each year will also include the AWP for the subsequent year, with projected disbursements and an updated procurement plan. The reports will be reviewed at semiannual meetings between the Bank and the executing agency.
- 4.10 The Bank will have the support of specialized consulting firms or individual consultants during project execution in order to ensure adequate supervision and monitoring of the project's technical, economic, financial, and environmental dimensions. The expectation is that this will make it possible to identify, in advance, potential obstacles and inconsistencies in the works and in the actions and decisions of the contractors, the PEU, and other actors involved. The Bank team will visit the works on a quarterly basis, in addition to maintaining an ongoing dialogue with the PEU.
- 4.11 **Evaluation.** The executing agency will deliver to the Bank: an evaluation report 18 months into the execution period, counted from the date on which the loan is declared eligible for disbursement; a midterm report within 60 days after the date on which 50% of the loan proceeds have been disbursed; and a final evaluation within 60 days after the date on which 90% of the loan proceeds have been disbursed. Terms of reference for these reports will require the Bank's no objection. These reports will cover, *inter alia*: (i) progress towards the targets identified in the results matrix; (ii) the degree of fulfillment of the contractual obligations; (iii) the effectiveness of the monitoring and evaluation system; and (iv) lessons learned. The reports will be made available to the executing agency or the Bank if either decides to conduct an ex post review after completion of the MHP.